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SELF SIMILARITY OF INCLUDING OF GRAPHITE IN CAST-IRONS

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Comparative morphological analysis of graphite inclusions in ductile iron and graphite complexes, which were separated from liquid metal during crystallization and often precipitated in pores and cavities, was realized.

It was determined that crystals and graphite inclusions at various scale factor have self-similarity and almost identical morphology. Graphite complexes separated from liquid metal and compact graphite inclusions in ductile cast iron have the same form as elementary form of graphite hexagonal lattice. Therefore formation of globular inclusions in cast irons occurs in accordance with own hexagonal nature of graphite.

Keywords: graphite inclusions, morphology, self-similarity, hexagonal lattice, fractal theory

Factors of forming of graphite in cast-irons a long ago are the article of discussions and disputes of physical metallurgy. In cast-irons a graphite which has an hexagonal grate can create the most various forms of including: lamellar, spherical, flaky, vermicular and other. Formations of that or other form bind to many phenomena: surface-tension or resistance of environment, by the presence of admixtures, nature, form or structure of embryos of graphite, by correlation of height of different verges of graphite and others like.

In work there are determined morphology of graphite masses, that it was got under various conditions: spherical including of graphite in cast-irons which are treated by magnesium, including of graphite, which are displaced at crystallization and put aside in pores and shells, graphite foam which is distinguished from primary domain cast-iron (spill).

On numerous experimental data of domestic and foreign researchers it is shown, that in clean iron-carbon alloys, smelted in a vacuum, spherical graphite is created without the use of the special additions which give to including of graphite of spherical form. It can testify that creation of spherical form of graphite, regardless of composition of alloy and method there is its pyrogenating, inherent actually to nature of graphite. Basic areas grow athwart to the radius of including, forming polyhedron which is identified in plane microsection as a spherical including. Thus, role of elements, that balling promote in industrial cast-irons with high content of admixtures often bind to the affinage of fusion, moving away of sulphur, oxygen and other harmful elements.

Especially interesting is a hypothesis of A.V. Sotsenko about the aggregative mechanism of forming of graphite on fractal nature. So, in works [1,2] new data appeared about fractal nature of the graphite including in cast-irons. One of main signs of such structure there is self similarity [3].

In graphite moulds poured purveyances of diameter 60 mm. From purveyances cut out microsections for a metallographic and spectrographic analysis which was executed with the use of microscopes of MIM-7 and «ZEISS. Epityp-2».

There are extracted including of graphite from the surface of microsection and from the shrink cavity for bar of high-strength cast-iron at the binocular microscope of MBS-2 by means of preparative needle. Also there are investigated graphite including in high-strength cast-iron for sort VCH500-2 (ДСТУ 3925-99), which is applied for the oiling purveyances of piston-rings. Also there are selected spill from primary domain cast-iron of production of OAJ «Metallurgical combine of «Zaporozhsteel′».

Using immersion liquids, there are carried out spectrographic researches on the crystal optics microscope of MIH-8. In the communicating light there is determined a form, sizes and other properties of the graphite including.

The executed researches showed that form of including of graphite in cast-irons after treatment modifiers, and also form of graphite complexes which are distinguished on the surface of shrink cavities, and also from liquid domain cast-iron is very alike.

In the cut of microsection there is often look after six sectors which form the spherical including of graphite. A microstructure of such including is heterogeneous and consists of plenty of packages-aggregates of graphite crystals of different form, sizes, with different optical and physical and chemical properties. So, the extracted from the surface of microsection of particle of graphite are very various on form and optical properties. Some of them (thin lamellar crystals of graphite of hexahedral form) light-grey color, transparent, optically anisotropic with the high factor of light refraction 1.98-2.03. Other packages-aggregates of graphite crystals grey color, isotropic, opaque with a mat surface. Next to the noted forms there are other present combinations of hexahedral a aggregates, and also particles, without crystallography borders or pellicle black with metal similar brilliance.

Forcing of atoms of graphite out of liquid cast-iron and laying of them in pores and shells forms the graphite crystals much the same hexahedral form which was observed in the metallic matrix of cast-iron. On morphological signs these including are identical. Research of graphite crystals (spill) exposes a mainly hexahedral form also.

Conclusions.

Thus, treatment of liquid cast-iron modifiers, which assist formation of spherical form of graphite results in treason of conditions of height of graphite crystals, assists the increase of graphite as a compact including. Including of graphite abstracted from a liquid metal have the same form as well as elementary form of hexagonal grate of graphite. It is therefore possible to assume that formation of the spherical including takes place according to own hexagonal nature of graphite. Crystals and including of graphite on a different scale factor have self similarity. Formation of spherical form of graphite at treatment of cast-iron place is taken modifiers as a result of indemnification of influence of resistance of environment on natural formation of hexahedral form of including.

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